1,145,208

PATENT SPECIFICATION

DRAWINGS ATTACHED

1,145,208

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COMPLETE SPECIFICATION

Improvements in or relating to Remotely Controllable Electromagnetic Switches for use at Radio Frequency

We, MARCONI INSTRUMENTS LIMITED, a British company, of English Electric House, Strand, London, W.C.2., do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to remotely controllable switches for use at radio frequency.

As is well known the characteristic impedance of a transmission line employed for radio frequency signals should be constant over its entire length, because any sharp change or impedance discontinuity will cause reflection of the radio frequency energy and set up a standing wave in the line and cause energy loss. In switchable transmission line systems in which lengths of line are required to be selectively switched or connected to other lengths of line it is, of course, necessary that the foregoing requirement be satisfied as respects the switching devices or line length connectors themselves, that is to say the switches or connectors must not themselves introduce serious impedance discontinuities. This does not present any great difficulty where the switching or inter-line connectors are intended for manual operation. Thus, for example, a number of line lengths required to be connected in different ways may be brought to a panel of sockets and the required connections made by plug-ended flexible coaxial "jumper" cables which can be pushed into selected sockets to interconnect them and which have the same characteristic impedance as the lengths of line which terminate in said sockets. Alternatively, in place of flexible coaxial jumper cables, short lengths of rigid coaxial able, bent into U shape, could be used to establish the required inter-connections between sockets, the U-shaped inter-connectors being again of the same characteristic impedance as the line lengths to be connected thereby and the sockets being, of course, so disposed that sockets which may be required to be inter-connected are spaced apart, on the socket panel, by the same distance as the limbs of the U of a U-connector. Arrangements as just described, however, obviously do not lend themselves to remote control and great difficulties are experienced in producing satisfactory remotely controllable radio frequency switching devices which will satisfy the requirement of good freedom from impedance discontinuities and which shall be, at the same time, compact, relatively cheap and simple to manufacture, reliable, capable of performing rapid switching operations, and of long operating life. The present invention seeks to overcome these difficulties.

According to this invention a remotely controllable radio frequency switch device includes at least one remotely controllable reed switch having its co-operating switch conductors co-axially mounted within a metal tube, and remotely actuatable electromagnetic means for bringing said conductors into or out of contact, said metal tube being electrically connected to a metal sheet constituting a ground plane and situated on one face of a dielectric sheet on the other face of which are lengths of metal strip through which connections are made to said switch conductors, the strips and switch conductors being so dimensioned as to constitute, with said dielectric sheet and ground plane sheet, a length of strip-line which is interruptable at the switch and has the same characteristic impedance as line lengths which the device is intended to interconnect.

Preferably the metal tube is fitted into a hole formed in the dielectric sheet so that the strips and switch conductors are at least approximately co-planar near the surface of said dielectric sheet remote from the ground plane sheet.

Such electro-magnetic means may be constituted by a coil round the metal tube. Other arrangements are, however, possible. Thus, in order to reduce to a minimum coupling between the switching electro-magnet and the radio frequency circuit through the strips and

[*Price 4s. 6d.*]

switch conductors the ground plane sheet may be made continuous and the switch actuated by the magnetic field produced by a core carrying a winding and operating through a screen constituted by said ground plane sheet so that the electro-magnet can be placed close to the movable reed of the switch but be nevertheless screened from the radio frequency field.

The connectors are preferably coaxial cable sockets with their outers fitted on and electrically connected to the ground plane sheet and their inners projecting through holes in said sheet and the dielectric sheet and connected to the strips.

A multiple or distributing switch device in accordance with this invention may comprise a plurality of remotely controllable switches as above set forth each with its own actuating means and each with its metal tube connected to a common metal ground plane sheet on one face of a common dielectric sheet on the other face of which are strips through which connections are made to the reeds of the switches.

The invention is illustrated in the drawings accompanying the provisional specification in which:

Figure 1 is a simplified perspective view of one embodiment of the invention;

Figure 2 is a broken away simplified perspective view showing the interior of the switch incorporated in the embodiment of Figure 1;

Figure 3 illustrates a modification, and

Figure 4 shows a multiple or distributing switch device in accordance with the invention. Like references denote like parts throughout.

Referring to Figure 1, a sheet 1 of dielectric material has, on one face, a deposited metal sheet 2. In a suitably shaped hole 4 in the sheets 1 and 2 is fitted by any suitably means (not shown) a remotely controllable reed switch, generally designated S, and the internal construction of which will appear from Figure 2. The switch 2 has, coaxially mounted within a cylindrical tubular metal housing S1, two switch conductors S2, S3, of magnetic material. The switch is normally open and is shown in this state in Figure 2 but by passing a switching current through its actuating coil S5 round the tube S1 the magnetic conductors S2 and S3 are attracted to one another and contact is established between them thus closing the switch. The housing S1 is electrically bonded to the metal sheet 2. The conductors S2 and S3 are electrically bonded to two strip conductors 3, 4 deposited on the face of the sheet 1 remote from the sheet 2. Lengths (not shown) of coaxial transmission line are connected to the device by socket connectors at the two ends of the device. Each connector has an outer conductor portion 5 or 6 which makes connection with the outer of a plugged-in coaxial line (not shown) and is held against and in contact with the metal ground plane sheet 2 by screws 7 or 8. The inner 9 or 10 of each connector is brought up through a hole 11 or 12 in the sheets 1 and 2 and bonded electrically to the end of the strip 3 or 4.

The strips 3 and 4, in conjunction with the sheets 1 and 2, constitute a length of strip line which, when the coil S5 is de-energised, is open circuited at the switch and, when said coil is energised, provides a through circuit. The parts are so dimensioned, in accordance with well known principles, that the characteristic impedance of the strip line, when the switch is closed, is the same as that of the lines (not shown) plugged into the socket connectors and so that there are, as nearly as possible, no impedance discontinuities.

As will be apparent there will be considerable coupling between the switch actuating coil S5 and the radio frequency circuit between the socket connectors through strip conductor S2, and strip conductor S3. In some cases this may be objectionable as causing undesirable leakage effects. It can, however, be reduced to normally negligible proportions by making the ground plane sheet 2 continuous, extending it under the housing S1 so that it constitutes a screen, and actuating the contacts S2, S3 by a magnetic field operating through this screen. One arrangement of this nature is shown in Figure 3 which is largely self-explanatory. As will be seen, the actuating magnetic field is provided by a core C having pole pieces between which the appropriate part of the tube housing S1 of the switch is situated and provided with an energising coil referenced $S5^1$.

Figure 4 shows one example of an embodiment constituting a multiple or distributing switch device.

In this particular embodiment an input coaxial cable can be switched to any of four output coaxial cables. Each cable (the cables are not shown) is plugged into its appropriate receiving socket only one of which appears in Figure 4. The input point, beneath which is the input cable socket, is indicated by IN and the four output points, beneath which are the output cable sockets, are indicated by O1, O2, O3, and 04. Only the output socket OS2 appears in Figure 4. There are six reed contact units 1S, 2S, 3S, 4S, 5S and 6S mounted in the common dielectric sheet 1 with its common metal ground plane sheet 2, each having its own actuating coil on a magnetic core. Only one coil S^13 and core C3 appears in the figure. By closing contact units 1S and 2S connections can be made between points IN and O1 and connection may be made between IN and O2, O3 or 04 by closing contact units 1S and 3S, or 4S and 5S or 4S and 6S respectively. By suitable selection, in accordance with known principles, the relative positions of the switches associated with any particular switching function, undesired stub effects created by open switches may be minimised to ensure more efficient transmission through closed switches.

In Figure 4 the whole apparatus, except for the socket connectors, are within an earthed screening box SB to the bottom of which said connectors are affixed, holes being, of course, provided in the bottom to pass the inner connections of the connectors.

If a greater degree of isolation is required between the four output cables and the input cable this may be achieved by adding one or more suitably positioned reed contact units in series between the reed contact units 2S and the output point O1 and similarly adding one or more additional reed contact units in between 03 and 02 and between 5S and 03 and between 6S and 04.

WHAT WE CLAIM IS:—

1. A remotely controllable radio frequency switch device including at least one remotely controllable reed switch having its co-operating switch conductors coaxially mounted within a metal tube, and remotely actuatable electromagnetic means for bringing said conductors into or out of contact, said metal tube being electrically connected to a metal sheet constituting a ground plane and situated on one face of a dielectric sheet on the other face of which are lengths of metal strip through which connections are made to said switch conductors, the strips and switch conductors being so dimensioned as to constitute, with said dielectric sheet and ground plane sheet, a length of stripline which is interruptable at the switch and has the same characteristic impedance as line lengths which the device is intended to interconnect.

2. A device as claimed in claim 1 wherein the metal tube is fitted into a hole formed in the dielectric sheet so that the strips and switch conductors are at least approximately co-planar near the surface of said dielectric sheet remote from the ground plane sheet.

3. A device as claimed in claim 3 wherein said electro-magnetic means are constituted by a coil round the metal tube.

4. A device as claimed in claim 3 wherein the ground plane sheet is made continuous and the switch conductors are actuated by the magnetic field produced by a core carrying a winding and operating through a screen constituted by said ground plane sheet.

5. A device as claimed in any of the preceding claims wherein the connectors are coaxial cable sockets with their outers fitted on and electrically connected to the ground plane sheet and their inners projecting through holes in said sheet and the dielectric sheet and connected to the strips.

6. A multiple or distributing switch device comprising a plurality of remotely controllable switches as claimed in any of the preceding claims each with its own actuating means and each with its metal tube connected to a common metal ground plane sheet on one face of a common dielectric sheet on the other face of which are strips, through which connections are made to the reeds of the switches.

7. Radio frequency switch devices substantially as herein described and illustrated in the drawings accompanying the provisional specification.

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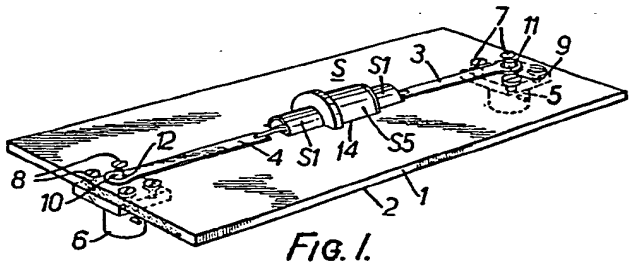

FIG. 1.

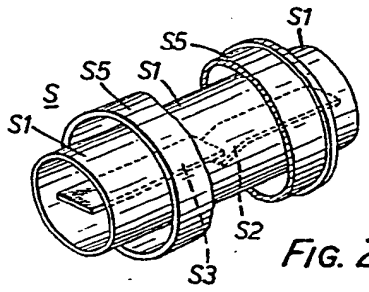

FIG. 2.

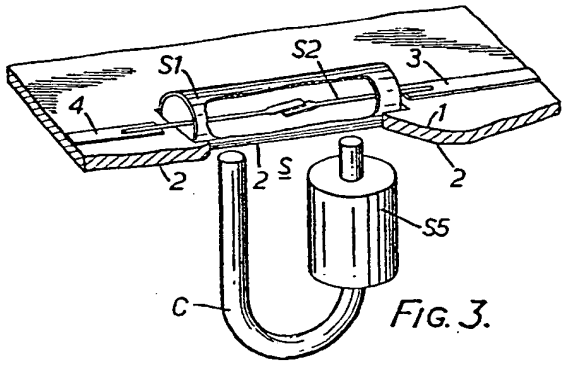

FIG. 3.

1145208 PROVISIONAL SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale.*

Sheets 1 & 2

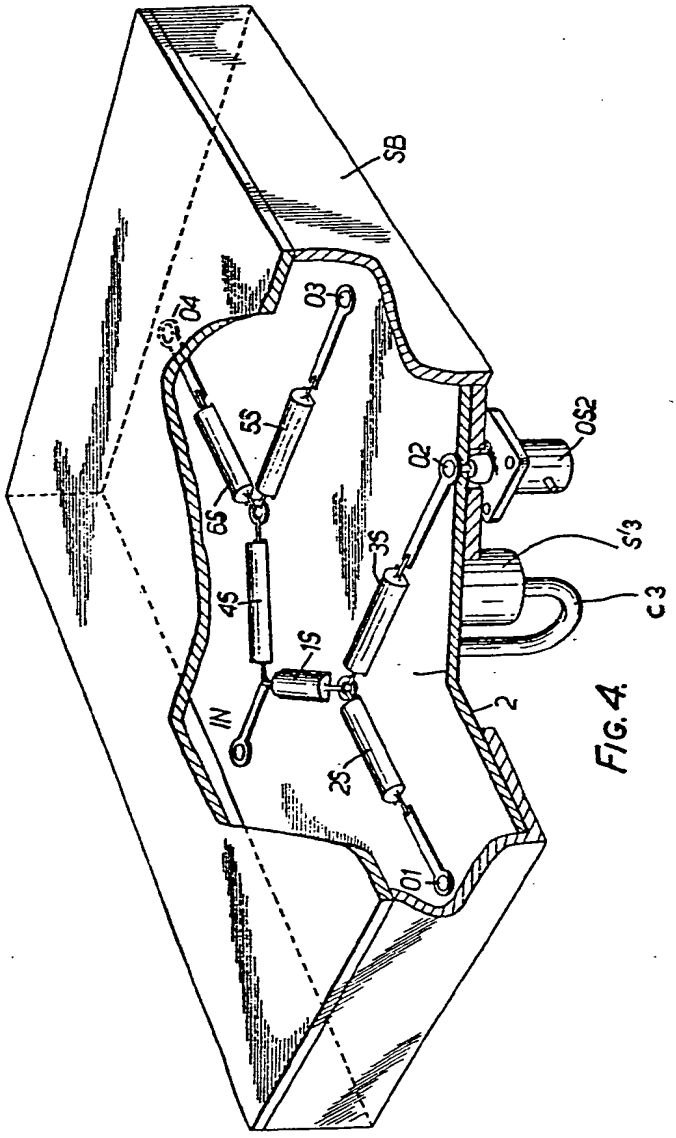

FIG. 4.

1145208 PROVISIONAL SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheets 1 & 2

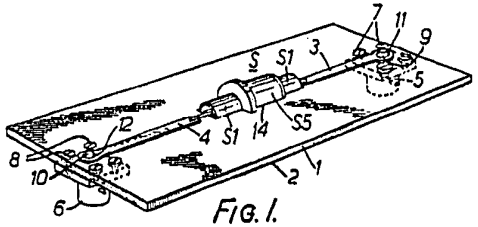

FIG. 1.

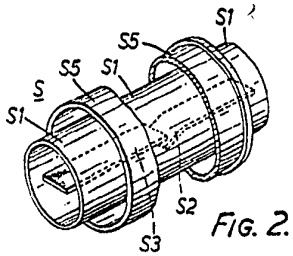

FIG. 2.

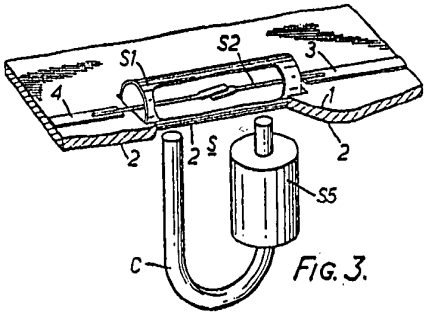

FIG. 3.

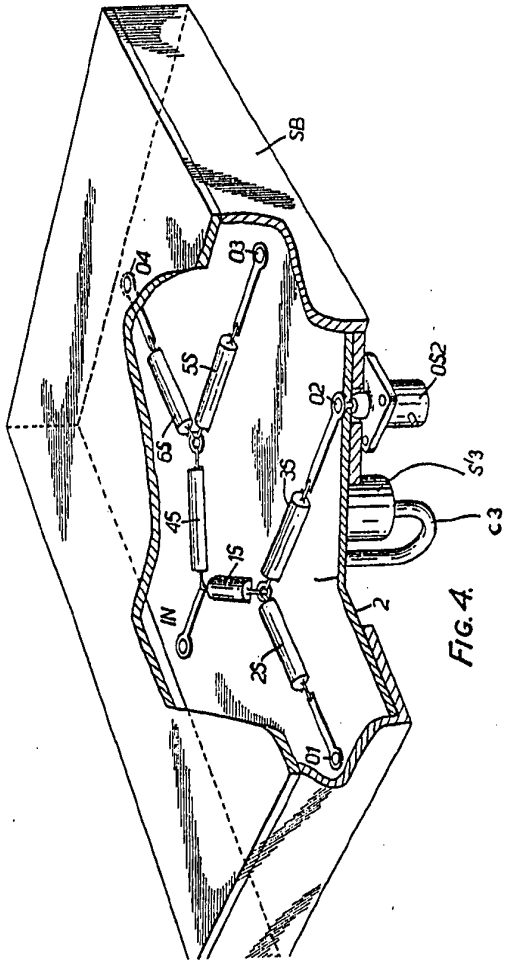

FIG. 4.